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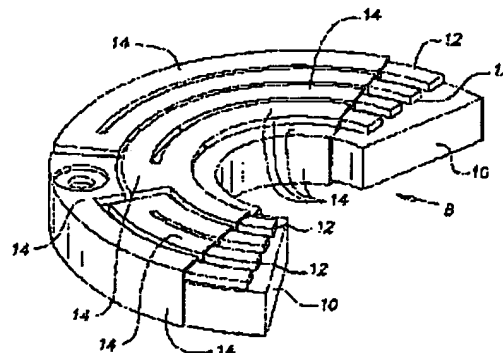
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(54) 【発明の名称】 化学蒸着により窒化アルミニウムで被覆した部材

## (57) 【要約】

ここに公開する化学蒸着 (CVD) 窒化アルミニウムで被覆した部材は、加熱部材、ウエハキャリア又は静電気チャックとして使用される。該部材は、窒化アルミニウム又は窒化ホウ素からなる基板 (10) を有し、さらに、抵抗加熱 (12、28) 又は電磁チャック (30) 或いはそれら両方として1つ以上の黒鉛要素 (12) を有する。基板 (10) と CVD 窒化アルミニウム膜 (16) の間に熱分解窒化ホウ素の層 (14) を挿入することができ、該窒化ホウ素層は1つ以上の黒鉛要素 (12) を含んでも含まなくてもよい。



(2)

特表2003-515257

**【特許請求の範囲】**

【請求項1】 基板と該基板に隣接する熱分解黒鉛とを有する本体と、化学蒸着により形成した窒化アルミニウムの外膜とを有する部材であって、加熱要素、静電気チャック及びウエハキャリヤから選択された用途に使用され、該外膜は洗浄成分による化学的破壊作用から部材を保護する目的で施されている部材。

【請求項2】 外膜の厚さが約10-100マイクロメートルである請求項1に記載の部材。

【請求項3】 前記外膜は部材外面のほぼ全体を覆っている請求項1に記載の部材。

【請求項4】 前記熱分解黒鉛要素は電極を有している請求項1に記載の部材。

【請求項5】 前記熱分解黒鉛要素は抵抗加熱要素を有している請求項1に記載の部材。

【請求項6】 前記抵抗加熱要素の厚さは約0.001-0.006インチである請求項5に記載の部材。

【請求項7】 基板は熱分解窒化ホウ素プレートである請求項1に記載の部材。

【請求項8】 基板は黒鉛プレートであって、さらに熱分解窒化ホウ素の被膜を有する請求項1に記載の部材。

【請求項9】 基板はホットプレスによる窒化ホウ素プレートである請求項1に記載の部材。

【請求項10】 基板はさらに熱分解窒化ホウ素の被膜を有する請求項9に記載の部材。

【請求項11】 本体に隣接し、本体と外膜の間に配置された熱分解窒化ホウ素の層をさらに有する請求項1に記載の部材。

【請求項12】 基板は熱分解窒化ホウ素プレートである請求項11に記載の部材。

【請求項13】 基板は黒鉛プレートであって、さらに熱分解窒化ホウ素の被膜を有する請求項11に記載の部材。

(3)

特表2003-515257

【請求項14】 基板はホットプレスによる窒化ホウ素プレートである請求項11に記載の部材。

【請求項15】 基板はさらに熱分解窒化ホウ素の被膜を有する請求項14に記載の部材。

【請求項16】 基板は窒化アルミニウムである請求項1に記載の部材。

【請求項17】 第2の熱分解黒鉛要素は基板に隣接して配置され、該基板が2つの熱分解黒鉛要素の間に配置されている請求項16に記載の部材。

【請求項18】 第1の熱分解黒鉛要素が抵抗加熱要素であり、第2の熱分解黒鉛要素が電極である請求項17に記載の部材。

【請求項19】 洗浄成分はNF<sub>3</sub>、プラズマである請求項1に記載の部材。

【請求項20】 外膜は部材を少なくとも100時間の洗浄時間にわたり有効に耐久させることができる請求項1に記載の部材。

(4)

特表2003-515257

**【発明の詳細な説明】****【0001】****【発明の属する技術分野】**

本発明は、概して化学蒸着により窒化アルミニウムで被覆した部材に関し、さらに詳細には、そのように被覆した加熱装置、ウエハキャリア及び静電気チャックに関する。

**【0002】****【発明の背景】**

コンピュータ集積回路（コンピュータチップ）の製造には、多くの物質層の蒸着及び選択的除去が必要である。シリコンウエハにこれら薄膜を形成する装置には様々な構成要素が使用され、それら構成要素には加熱要素、静電気チャック及びウエハキャリアが含まれる。

ウエハの被覆工程において、ウエハ或いはチップに被覆される物質は蒸着チャンバ内の装置、例えば加熱装置などにも蒸着する。このため定期的な洗浄が必要で、この洗浄には一般に高エネルギーガスプラズマが使用される。最も攻撃的なプラズマは、NF<sub>3</sub>等のフッ素系ガスを使用したものである。この処理により生成されるフッ化プラズマはチャンバを洗浄するが、一方で装置の構成要素に化学的な破壊作用を及ぼす。この侵食により構成要素及び装置の寿命が制限される。適当な耐性を持つ被覆を使用することにより、構成要素及び装置の耐用年数を延ばすことが望まれる。

**【0003】****【発明の概要】**

本発明により提供される被覆した部材は、加熱要素や静電気チャックやウエハキャリアなどとして使用される。該部材は基板及び黒鉛要素からなる本体と、化学蒸着による窒化アルミニウムの外膜を有する。外膜は例えばフッ化プラズマなどの化学的侵食から部材を保護する。

**【0004】****【発明の好適な実施例】**

以下の説明で、好適な範囲として例えば5から25が指定された場合、その範

(5)

特表2003-515257

図は、下限と上限がそれぞれ単独で、好ましくは少なくとも5であることと、好ましくは25未満であることを意味する。本明細書中及び請求の範囲で使用されているように、「隣接する」という語は、2つの層又は物体の間に挿入された層が存在する場合に、直接接しているという意味と、近くにあるという意味の両方を含んでいる。後者の場合が図3で示されている。ここで窒化アルミニウムの外部層16は熱分解窒化ホウ素からなる基板10及び熱分解黒鉛からなる抵抗体12に隣接しており、熱分解窒化ホウ素の層14が基板10と外部層16の間に挿入されている。

## 【0005】

本発明は被覆した部材に関する。該被覆した部材は加熱部材や静電気チャックやウエハキャリヤや類似の部材として使用される。いずれの場合も、部材は基板及び黒鉛要素を含む本体と、それに隣接して化学蒸着による窒化アルミニウムの被膜を有する。

## 【0006】

図1は、オハイオ州クリーブランドのアドバンスド セラミクス コーポレーション (Advanced Ceramics Corporation) がBoralelectricという商品名で提供している、熱分解窒化ホウ素 (PBN) からなる、当該技術分野において公知の抵抗加熱部材を示している。加熱部材は抵抗体8及び1対の接続柱11を有し、例えば、表層を化学蒸着する間シリコンウエハを加熱するために使用される。接続柱はそれらの基部の電源から抵抗体へ電気を伝える役割を果たす。このPBN加熱部材及びその構造と使用については、米国特許第5343022号に詳細に記載されており、参照によりその内容を本明細書に包含する。

## 【0007】

加熱部材の抵抗体8は図2でより詳細に示されている。図示された抵抗体8は、約0.02-0.12インチ、さらに好適には約0.05インチの厚さを持つPBN基板10と、該基板上に約0.001-0.006インチ、さらに好適には約0.002-0.003インチの厚さを持つ導電性の湾曲した熱分解黒鉛 (PG) 要素12とを有している。加熱器内の熱分解黒鉛要素は、熱分解黒鉛からなる抵抗要素であるか、公知の典型的な抵抗を有する加熱部材である。PG抵抗

(5)

特表2003-515257

要素は化学蒸着（CVD）によって提供され、通常機械加工により所望の形状（湾曲）に形成される。基板及び抵抗要素は抵抗体の本体を形成する。本体のほぼ全体は、加熱装置全体に実行されたCVDにより供給された約0.005-0.04インチ、さらに好適には約0.01-0.02インチの厚さを持つ均質な保護PBN膜14で覆われている。該PBN膜14は酸化に対する耐性があり、電気絶縁性と化学的及び機械的な保護とを供給し、さらに炭素による汚染の可能性を最小化する。これについて、米国特許第5882730号及び同第5702764号を参照し、参照によりその内容を本明細書に包含する。

## 【0008】

図3は、図1及び2で示したPBN加熱部材を、化学蒸着による窒化アルミニウム（CVD-AlN）の保護外膜16で被覆したものを図解している。図3に示すように、本体は基板10及びPG要素12を有している。該本体はPBN層及びCVD-AlNで被覆されている。部材の外表面の全体又はほぼ全体は、最も外側にあるCVD-AlNの被膜で覆われている。

## 【0009】

本発明による部材をシリコンウエハの加工に使用する。この加工工程には化学蒸着によるウエハ表面の物質層生成が含まれるので、該部材もまた加工中に同物質で被覆されることになり、定期的な洗浄の必要性が生じる。通常ウエハ表面の物質層生成が部材に損傷を与えることはない。しかしながら、NF<sub>3</sub>、プラズマなどの強い洗浄成分がこれら部材の洗浄にしばしば使用される。この洗浄は、典型的には30-40工程時間、つまり30-40時間ウエハ加工を行った後行われる。このとき部材には、一般に1-2洗浄時間又はそれ未満のプラズマ洗浄を施す。PBNでのみ被覆されている部材は、一般にNF<sub>3</sub>、プラズマに50-100洗浄時間曝すことにより損傷を受け、取替えが必要になる。CVD-AlN被膜はPBN被膜に比べNF<sub>3</sub>、プラズマの破壊作用に非常に強い耐性を有しており、試験的にNF<sub>3</sub>、プラズマを使用して12-24時間洗浄を行った後、所見できる損傷はなかった。本発明による部材は好適には、少なくとも10、25、50、100、200、300、400、500、600、700、800、900、1000、1500、2000、3000及び4000時間にわたる洗浄時間、

(7)

特表2003-515257

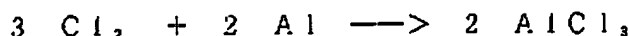
つまりNF。プラズマによる破壊作用を受ける時間を経ても、有効に耐久する、すなわち、部材を保護された状態に保ち、該被覆した部材を取り替える必要が生じないほど、十分なCVD-AINの被膜を有する。これを達成するために、CVD-AIN外膜16は好適には10-100ミクロン、さらに好適には30-80ミクロン、最適には50-60ミクロンの厚さである。

## 【0010】

CVD-AIN被膜の生成工程は公知である。例えば米国特許第4950558号、同第5672420号、同第4239819号、同第5178911号、同第4172754号及び同第5356608号を参照し、これら特許の記載内容を参照により本明細書に包含する。図4はAlCl<sub>3</sub>及びNH<sub>3</sub>を使用したCVD-AIN工程を図解している。概略すると、蒸着工程は蒸着チャンバ52と接続する塩素処理チャンバ44を有する反応器40内で行われる。蒸着チャンバは真空チャンバ54内に配設され、該真空チャンバ54は1つ以上の真空ポンプに接続している。処理を開始する前に、被覆基板58を蒸着チャンバ内に配置し、塩素処理チャンバ44にアルミニウム粒子48の床を敷き、その後真空チャンバ及び蒸着チャンバを排気しておく。

## 【0011】

処理工程ではまず、抵抗加熱要素46により塩素処理チャンバを200度から400度の間に加熱する。塩素(Cl<sub>2</sub>)及び窒素(N<sub>2</sub>)ガスを、パイプ42を介して塩素処理チャンバに導入する。この温度において、アルミニウムと塩素が反応し、塩化アルミニウムガスを生成する：

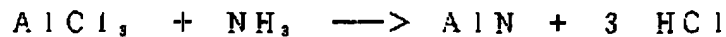


## 【0012】

次に塩化アルミニウムが蒸着チャンバ52に進む。該蒸着チャンバは工程前の処理により排気されており、内圧は約1-10トル、好ましくは約2トルという低圧になっている。アンモニア(NH<sub>3</sub>)及び水素(H<sub>2</sub>)を入口50から蒸着チャンバに注入する。抵抗加熱器56により、温度を700度から800度の間、好ましくは750度に維持する。その後、塩化アルミニウムとアンモニアを反応させて生成したAINで被覆基板58を被覆する：

(8)

特表2003-515257



## 【0013】

被膜は1時間に約10-20マイクロメートルの割合で被覆部材58上に堆積する。化学蒸着による窒化アルミニウムの被膜は焼結やホットプレスによる被膜よりも、濃度及び純度で優れ、また本質的に均一な厚さを有している。上述の方法で作られた被膜は窒化アルミニウムの理論的結晶質濃度の85-90%の濃度を有している（理論的AlN結晶質濃度=3.26g/cc）。蒸着チャンバをさらに高温の900度にして生成した被膜の濃度はさらに高く、理論的結晶質濃度の97-100%となる。他の技術及び材料を使用した他のCVD-AlN被膜工程も、当該技術分野において公知であり、それらすべてを参照により本明細書に包含する。

## 【0014】

本発明による別の実施例では、被膜16を排除し且つPBN膜14をCVD-AlN膜18に代えて、図3の加熱装置を使用することができ、この実施例を図5に示す。CVD-AlN膜18の厚さは、好適には約10-100マイクロメートル、さらに好適には約30-80マイクロメートル、最適には約50-60マイクロメートルであり、また約5-50マイクロメートルでもよい。

## 【0015】

図3及び5は従来のPBN基板10の使用例を示す。代替案として、図3及び5のPBN基板10の代わりに、(1)PBNで被覆した黒鉛プレート（黒鉛プレートの厚さは約0.10-0.75インチか又は0.12-0.50インチ、及びPBN膜の厚さは約0.005-0.035インチ、さらに好適には約0.015-0.020インチ）、(2)厚さ0.10-0.75インチ、さらに好適には約0.25-0.50インチのホットプレスによる窒化ホウ素（BN）プレート、又は(3)PBNで被覆したホットプレスによるBNプレート（ホットプレスによるBNプレートの厚さは約0.10-0.75インチ、さらに好適には約0.25-0.50インチ、及びPBN膜の厚さは約0.005-0.035インチ、さらに好適には約0.01-0.02インチ）を使用することもできる。



(9)

特表2003-515257

## 【0016】

図6は図3及び5の加熱要素に類似した加熱要素を示しているが、それは別の物質からできている。図6の加熱装置は、ホットプレス、鋳造又はその他の従来技術により形成された、約0.05-0.5インチ、さらに好適には約0.1-0.2インチの厚さを持つAlNバルク基板20を有している。加熱装置はまた、CVDによる約0.001-0.006インチ、さらに好適には約0.002-0.003インチの厚さを持ち、PG抵抗要素12に類似の熱分解黒鉛抵抗要素22を有し、さらに厚さ約10-100マイクロメートル、さらに好適には約30-80マイクロメートル、最適には約50-60マイクロメートルのCVD-AlN外膜24を有する。或いは、図6は、厚さ約0.05-0.5インチ、さらに好適には約0.1-0.2インチの同様のAlNバルク基板20と、厚さ約0.001-0.006インチ、さらに好適には0.002-0.003インチの1つ以上のCVD熱分解黒鉛静電気チャック電極22と、約10-100マイクロメートル、さらに好適には約30-80マイクロメートル、最適には約50-60マイクロメートルのCVD-AlN外膜24とを有する静電気チャックでもよい。静電気チャックの構造設計及びその操作に関しては、米国特許第5591269号、同第5566043号、同第5663865号、同第5606484号、同第5155652号、同第5665260号、同第5909355号及び同第5693581号を参照し、それらの内容を参照により本明細書に包含する。

## 【0017】

随意で、図6の加熱要素及び図6の静電気チャックを1つの装置に結合することができ。図7はそのような結合装置を図解したものであり、AlNバルク基板20と同じ物質からなり同じ厚さを持つ支持基板26と、前記抵抗要素22と同じ材料からなり同じ厚さを持つ発熱層28と、前述で静電気チャック要素又は電極として設定された熱分解黒鉛導体又は静電気チャック電極22と同じ物質からなり同じ厚さを持つ静電気チャックのための電極30と、CVD-AlN外膜24と同じ材料からなり同じ厚さを持つ被覆層32を示している。

## 【0018】

随意で、図3、5又は6に示した加熱要素、図6に示した静電気チャック又は

(10)

特表2003-515257

図7に示した加熱要素と静電気チャックの結合装置を、処理工程においてウエハをある位置から別の位置へ移動するためのウエハキャリアとして使用することができる。この場合、図解した実施例のいずれもが、アーム（図示しない）を有し、加熱器又はチャック又は過熱器／チャックを所望の位置へ搬送する手段をさらに有する。図に示したウエハキャリアの部分（被覆した本体）は、チップ及びウエハを別の位置に搬送する際に、へらの平らな部分に類似した機能を担う。加熱要素を内蔵するウエハキャリアは、ウエハを所望の温度に予熱すること又は所望の温度で保温することができる。静電気チャックを内蔵するウエハキャリアは、高速の移動及び処理時間の短縮を可能にする。図7に示したようなどちらの機能も内蔵するウエハキャリアは、両者の利点を併せ持っている。しかしながら、ウエハキャリアをうまく標準チップ又はウエハラックに組み込むためには、被覆した本体の厚さが全体で約3mm未満でなければならない。よって、本発明による結合したウエハキャリアの厚さは、全体で本体全体の厚さより薄い3mm未満でなければならない。

【0019】

本発明の好適な実施例を上記のように説明したが、請求の範囲に開示した本発明の範囲から逸脱することなく、実施例には様々な変形及び部品の配置換えが可能である。

【図面の簡単な説明】

【図1】

図1は本発明の使用に適する加熱部材の斜視図である。

【図2】

図2は図1の加熱部材の一部を拡大し、内部構成要素を明らかにするために部分的に切開した図である。

【図3】

図3は本発明による実施例を図解する部分的断面図である。

【図4】

図4は化学蒸着を実行する装置の図解したものである。

【図5】

(11)

特表2003-515257

図5は本発明による実施例を図解する部分的断面図である。

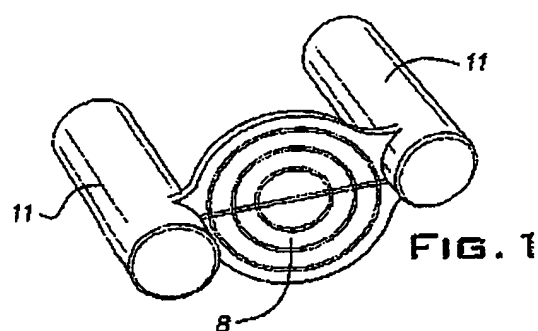
【図6】

図6は本発明による実施例を図解する部分的断面図である。

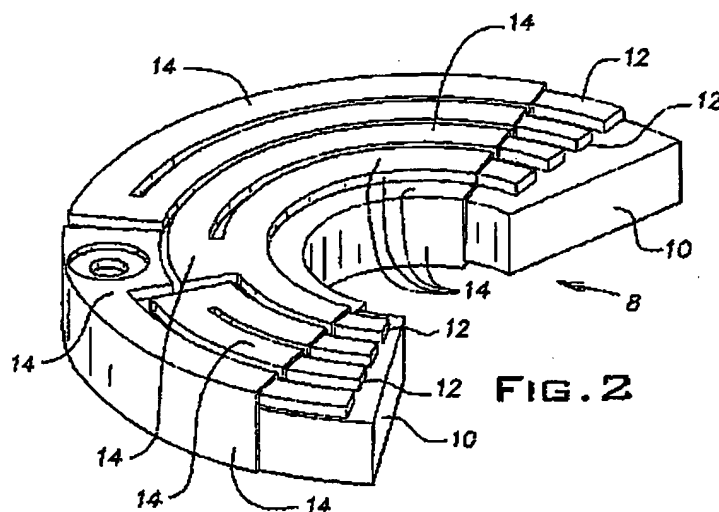
【図7】

図7は本発明による実施例を図解する部分的断面図である。

【図1】



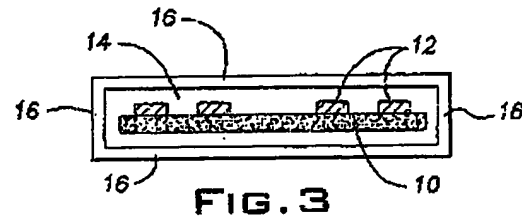
【図2】



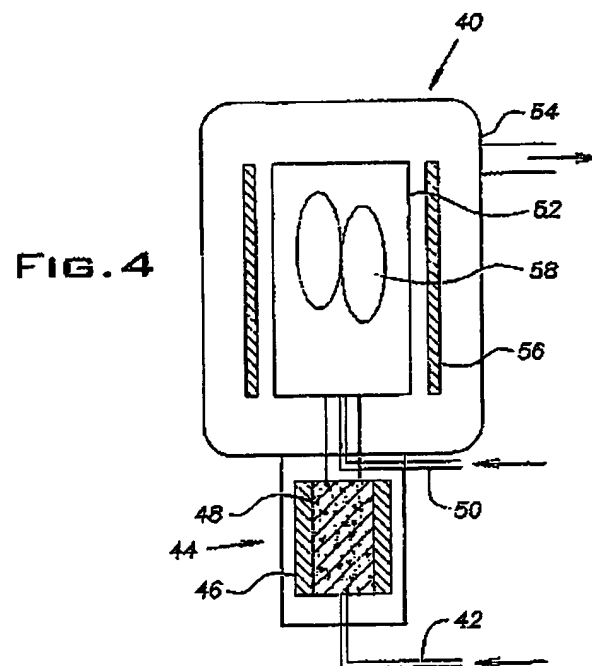
(12)

特表2003-515257

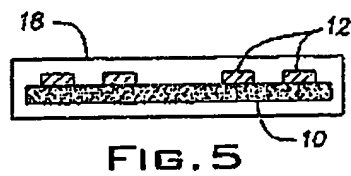
【図3】



【図4】



【図5】



(13)

特表2003-515257

【図6】

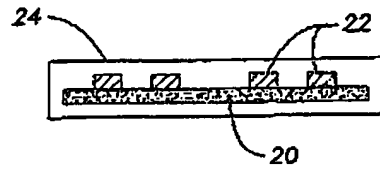


FIG. 6

【図7】

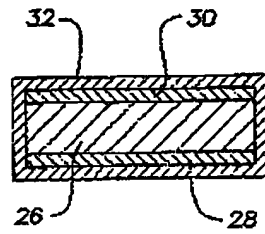


FIG. 7

(14)

特表2003-515257

## 【国際調査報告】

INTERNATIONAL SEARCH REPORT		International application No. PCT/US00/42236																		
<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC(7) : G23C 15/00; H02N 13/00 US CL : 118/725, 728; 414/217, 941 According to International Patent Classification (IPC) or to both national classification and IPC																				
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) U.S. : 118/725, 728; 414/217, 935, 937, 941; 156/245 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Please See Exam Sheet																				
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevance to claim No.</th> </tr> </thead> <tbody> <tr> <td>Y</td> <td>US 5,672,420 A (STINTON et al) 30 September 1997, entire document.</td> <td>1-20</td> </tr> <tr> <td>Y</td> <td>US 5,665,260 A (KAWADA et al) 09 September 1997, entire document.</td> <td>1-20</td> </tr> <tr> <td>Y</td> <td>US 5,663,865 A (KAWADA et al) 02 September 1997, entire document.</td> <td>1-20</td> </tr> <tr> <td>Y</td> <td>US 5,696,484 A (KAWADA et al) 25 February 1997, entire document.</td> <td>1-20</td> </tr> <tr> <td>Y</td> <td>US 5,591,269 A (ARAMI et al) 07 January 1997, entire document.</td> <td>1-20</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevance to claim No.	Y	US 5,672,420 A (STINTON et al) 30 September 1997, entire document.	1-20	Y	US 5,665,260 A (KAWADA et al) 09 September 1997, entire document.	1-20	Y	US 5,663,865 A (KAWADA et al) 02 September 1997, entire document.	1-20	Y	US 5,696,484 A (KAWADA et al) 25 February 1997, entire document.	1-20	Y	US 5,591,269 A (ARAMI et al) 07 January 1997, entire document.	1-20
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<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family member.																				
<table border="1"> <tbody> <tr> <td>* Special designation of cited documents</td> <td>* If any document published after the international filing date or priority date and not in conflict with the applicant has cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"A" documents defining the prior art of the invention as not considered to be of particular relevance</td> <td>"X" documents of particular relevance, the relevant portions cannot be considered or cannot be considered to be of particular relevance when the document is taken alone</td> </tr> <tr> <td>"E" certain documents published on or after the international filing date, documents which may show aspects of primary claims or which are cited to establish the publication date of another citation or which spread priority or novelty</td> <td>"Y" documents of particular relevance, the relevant portions cannot be considered to show an inventive step when the document is considered in view of the prior art</td> </tr> <tr> <td>"L" documents relating to the prior art, but not of particular relevance</td> <td>"A" documents of particular relevance, the relevant portions cannot be considered to show an inventive step when the document is considered in view of the prior art</td> </tr> <tr> <td>"P" documents published prior to the international filing date but later than the priority date claimed</td> <td>"A" documents of particular relevance, the relevant portions cannot be considered to show an inventive step when the document is considered in view of the prior art</td> </tr> </tbody> </table>			* Special designation of cited documents	* If any document published after the international filing date or priority date and not in conflict with the applicant has cited to understand the principle or theory underlying the invention	"A" documents defining the prior art of the invention as not considered to be of particular relevance	"X" documents of particular relevance, the relevant portions cannot be considered or cannot be considered to be of particular relevance when the document is taken alone	"E" certain documents published on or after the international filing date, documents which may show aspects of primary claims or which are cited to establish the publication date of another citation or which spread priority or novelty	"Y" documents of particular relevance, the relevant portions cannot be considered to show an inventive step when the document is considered in view of the prior art	"L" documents relating to the prior art, but not of particular relevance	"A" documents of particular relevance, the relevant portions cannot be considered to show an inventive step when the document is considered in view of the prior art	"P" documents published prior to the international filing date but later than the priority date claimed	"A" documents of particular relevance, the relevant portions cannot be considered to show an inventive step when the document is considered in view of the prior art								
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Date of the actual completion of the international search		Date of mailing of the international search report																		
20 MARCH 2001		16 APR 2001																		
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3720		Authorized officer JEFFREIE R. LUND Telephone No. (703) 305-0651																		

Form PCT/ISA/210 (second sheet) (July 1998) \*

(15)

特表2003-515257

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US00/42236

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Classen of document, with indication, where appropriate, of the relevant passages	Relevance to claim No.
Y	US 5,566,043 A (KAWADA et al) 15 October 1996, entire document	1-20
A	US 5,343,022 A (GILBERT et al) 30 August 1994, entire document	1-20

Form PCT/ISA/210 (continuation of second sheet) (July 1998) \*

(15)

特表2003-515257

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US00/41234

## B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

USPAT, EPO, JPO, DERWENT IBM TDB

Search terms: heating element, electrostatic chuck, wafer carrier, abuseries; nitride AlN, pyrolytic graphite, electrodes, resistive heating element, pyrolytic boron nitride, BN

Form PCT/ISA/210 (extra sheet) (July 1998) \*



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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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CLAIMS

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[Claim(s)]

[Claim 1] It is the member given in order to protect a member from a chemical destructive operation are the member which has the body which has pyrolytic graphite contiguous to a substrate and this substrate, and the adventitia of the aluminum nitride formed by chemical vacuum deposition, are used for the application chosen from the heater element, the static electricity chuck, and the wafer carrier, and according [ this adventitia ] to a washing component.

[Claim 2] The member according to claim 1 whose thickness of adventitia is about 10 - 100 micrometers.

[Claim 3] Said adventitia is a member of a member outside surface according to claim 1 which has covered the whole mostly.

[Claim 4] Said pyrolytic graphite element is a member according to claim 1 which has the electrode.

[Claim 5] Said pyrolytic graphite element is a member according to claim 1 which has the resistance heating element.

[Claim 6] The thickness of said resistance heating element is a member according to claim 5 which is about 0.001 - 0.006 inches.

[Claim 7] A substrate is a member according to claim 1 which is a pyrolysis boron nitride plate.

[Claim 8] A substrate is a member according to claim 1 which is a graphite plate and has the coat of pyrolysis boron nitride further.

[Claim 9] A substrate is a member according to claim 1 which is a boron nitride plate by the hotpress.

[Claim 10] A substrate is a member according to claim 9 which has the coat of pyrolysis boron nitride further.

[Claim 11] The member according to claim 1 which has further the layer of the pyrolysis boron nitride which adjoined the body and has been arranged between a body and adventitia.

[Claim 12] A substrate is a member according to claim 11 which is a pyrolysis boron nitride plate.

[Claim 13] A substrate is a member according to claim 11 which is a graphite plate and has the coat of pyrolysis boron nitride further.

[Claim 14] A substrate is a member according to claim 11 which is a boron nitride plate by the hotpress.

[Claim 15] A substrate is a member according to claim 14 which has the coat of pyrolysis boron nitride further.

[Claim 16] A substrate is a member according to claim 1 which is aluminum nitride.

[Claim 17] The 2nd pyrolytic graphite element is a member according to claim 16 by which a substrate is adjoined, it is arranged and this substrate is arranged between two pyrolytic graphite elements.

[Claim 18] The member according to claim 17 whose 2nd pyrolytic graphite element the 1st pyrolytic graphite element is a resistance heating element, and is an electrode.

[Claim 19] A washing component is a member according to claim 1 which is NF<sub>3</sub> plasma.

[Claim 20] Adventitia is the member according to claim 1 to which the durability of the member can be effectively carried out over at least 100-hour washing time amount.

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[Translation done.]

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## DETAILED DESCRIPTION

---

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

This invention relates to the heating apparatus, wafer carrier, and the static electricity chuck which were covered such in the detail further about the member which chemical vacuum deposition covered by aluminium nitride generally.

[0002]

[Background of the Invention]

A matter layer needs vacuum evaporatio and alternative removing by many for manufacture of a computer integrated circuit (computer chip). Various components are used for the equipment which forms these thin films in a silicon wafer, and a heater element, the static electricity chuck, and a wafer carrier are contained in these components.

In the covering process of a wafer, the matter covered by a wafer or the chip is vapor-deposited to the equipment in a vacuum evaporatio chamber, for example, heating apparatus etc. For this reason, periodical washing is required and, generally the high energy gas plasma is used for this washing. The fluorine system gas of NF<sub>3</sub> grade is used for the most offensive plasma. Although the fluoride plasma generated by this processing washes a chamber, a chemical destructive operation is exerted on the component of equipment by one side. The life of a component and equipment is restricted by this pervasion. To extend the life of a component and equipment is desired by using covering with suitable resistance.

[0003]

[Summary of the Invention]

The covered member which is offered by this invention is used as a heater element, the static electricity chuck, a wafer carrier, etc. This member has the adventitia of the body which consists of a substrate and a graphite element, and the aluminium nitride by chemical vacuum deposition. Adventitia protects a member from chemical attacks, such as for example, fluoride plasma.

[0004]

[The suitable example of invention]

When 5-25 are specified as suitable range by the following explanation, the range means that it is less than 25 as preferably as a minimum and an upper limit being independent, respectively and being at least 5 preferably. When the layer inserted between two layers or a body exists, the word of "adjoining" includes both the semantics of having touched directly, and the semantics of being in near, as used by the inside of this specification, and the claim. The case of the latter is shown by drawing 3. The external layer 16 of aluminium nitride adjoins the resistor 12 which consists of a substrate 10 which consists of pyrolysis boron nitride, and pyrolytic graphite, and the layer 14 of pyrolysis boron nitride is inserted between the substrate 10 and the external layer 16 here.

[0005]

This invention relates to the covered member. The covered this member is used as a heating component,

the static electricity chuck, a wafer carrier, or a similar member. In any case, a member adjoins the body containing a substrate and a graphite element, and it, and it has the coat of the aluminum nitride by chemical vacuum deposition.

[0006]

Drawing 1 is advanced [ of Ohio Cleveland ]. Ceramics The corporation (Advanced Ceramics Corporation) shows the well-known resistance heating member in the technical field concerned which consists of pyrolysis boron nitride (PBN) currently offered by the trade name of Boraletric. A heating component is used in order to heat a silicon wafer while having a resistor 8 and one pair of connection columns 11, for example, carrying out chemical vacuum deposition of the surface. A connection column plays the role which tells the electrical and electric equipment from the power source of those bases to a resistor. About a PBN heating component, and this structure and use, it is indicated by U.S. Pat. No. 5343022 at the detail, and those contents are included on these specifications by reference. [ its ]

[0007]

The resistor 8 of a heating component is shown more to the detail by drawing 2 . illustrating -- having had -- a resistor -- eight -- about -- 0.02 - 0.12 -- an inch -- further -- suitable -- about -- 0.05 -- an inch -- thickness -- having -- PBN -- a substrate -- ten -- this -- a substrate -- a top -- about -- 0.001 - 0.006 -- an inch -- further -- suitable -- about -- 0.002 - 0.003 -- an inch -- thickness -- having -- conductivity -- having curved -- pyrolytic graphite -- (-- PG --) -- an element -- 12 -- having -- \*\*\*\* . The pyrolytic graphite element in a heater is a resistance element which consists of pyrolytic graphite, or is a heating component which has well-known typical resistance. PG resistance element is offered by chemical vacuum deposition (CVD), and is usually formed in a desired configuration (curve) of machining. A substrate and a resistance element form the body of a resistor. The whole is mostly covered by the homogeneous protection PBN film 14 which was supplied by CVD of a body performed by the whole heating apparatus and which has still more suitably about 0.005 - 0.04 inches of thickness of about 0.01 - 0.02 inches. This PBN film 14 has the resistance over oxidation, supplies electric insulation and chemical and mechanical protection, and minimizes the possibility of contamination by carbon further. About this, the contents are included on these specifications by reference with reference to U.S. Pat. No. 5882730 and 5702764.

[0008]

Drawing 3 is illustrating what covered with the protection adventitia 16 of the aluminum nitride (CVD-AlN) by chemical vacuum deposition the PBN heating component shown by drawing 1 and 2. As shown in drawing 3 , the body has the substrate 10 and the PG element 12. This body is covered with a PBN layer and CVD-AlN. It is covered with the coat of the whole outside surface of a member, or CVD-AlN which the whole has in the outermost part mostly.

[0009]

The member by this invention is used for processing of a silicon wafer. Since the matter layer generation on the front face of a wafer by chemical vacuum deposition is included in this processing process, this member will also be covered with this matter during processing, and the need for periodical washing produces it. Usually, the matter layer generation on the front face of a wafer does not do damage to a member. However, strong washing components, such as NF<sub>3</sub> plasma, are often used for washing of these members. Typically, this washing is performed, after performing 30-40 process time amount, i.e., 30 to 40-hour wafer processing. Generally at this time, 1-2 washing time amount or plasma washing below it is performed to a member. Exchange is needed in response to damage by generally putting the member covered only with PBN to NF<sub>3</sub> plasma 50-100 washing time. The CVD-AlN coat had resistance very strong against a destructive operation of NF<sub>3</sub> plasma compared with the PBN coat, and after performing washing in a tentative way for 12 to 24 hours using NF<sub>3</sub> plasma, there was no damage which can carry out a view. The washing time amount suitably over [ at least ] 10, 25, 50, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1500, 2000, 3000, and 4000 hours in the member by this invention, That is, it has the coat of sufficient CVD-AlN, so that durability is carried out effectively, namely, it will not be necessary to exchange the member which maintained at the condition of having protected the member and was this covered, even if it passes through the time amount which receives the destructive

operation by NF<sub>3</sub> plasma. In order to attain this, 10 - 100 microns of 30 - 80 microns of CVD-AlN adventitious 16 are 50 - 60 microns in thickness the optimal still more suitably suitably.

[0010]

The generation process of a CVD-AlN coat is well-known. For example, with reference to U.S. Pat. No. 4950558, 5672420, 4239819, 5178911, 4172754, and 5356608, the written contents of these patents are included on these specifications by reference. Drawing 4 is illustrating the CVD-AlN process which used AlCl<sub>3</sub> and NH<sub>3</sub>. If an outline is carried out, a vacuum evaporation process will be performed within the reactor 40 which has the chlorination chamber 44 linked to the vacuum evaporation chamber 52. The vacuum evaporation chamber was arranged in the vacuum chamber 54, and this vacuum chamber 54 is connected to one or more vacuum pumps. Before starting processing, the covering substrate 58 is arranged in a vacuum evaporation chamber, the chlorination chamber 44 is covered with the floor of the aluminum particle 48, and the vacuum chamber and the vacuum evaporation chamber are exhausted after that.

[0011]

In down stream processing, a chlorination chamber is first heated between 200 degrees and 400 degrees with the resistance heating element 46. Chlorine (Cl<sub>2</sub>) and nitrogen (N<sub>2</sub>) gas are introduced into a chlorination chamber through a pipe 42. :3 which aluminum and chlorine react and generates aluminum chloride gas in this temperature  $\text{Cl}_2 + 2 \text{aluminum} \rightarrow 2 \text{AlCl}_3$  [0012]

Next, an aluminum chloride progresses to the vacuum evaporation chamber 52. This vacuum evaporation chamber is exhausted by the processing before a process, and about 1 to 10 torr of internal pressure is the low voltage of about 2 torr preferably. Ammonia (NH<sub>3</sub>) and hydrogen (H<sub>2</sub>) are injected into a vacuum evaporation chamber from an inlet port 50. With the resistance heating vessel 56, temperature is preferably maintained at 750 degrees for 700 to 800 degrees. Then, :AlCl<sub>3</sub> which covers the covering substrate 58 with AlN which an aluminum chloride and ammonia were made to react and was generated + NH<sub>3</sub>  $\rightarrow \text{AlN} + 3 \text{HCl}$  [0013]

A coat is deposited on the covering member 58 at a rate of about 10 - 20 micrometers in 1 hour. Rather than the coat by sintering or the hotpress, the coat of the aluminum nitride by chemical vacuum deposition is excellent in concentration and purity, and essentially has uniform thickness. The coat made by the above-mentioned approach has the concentration of 85-90% of the theoretical crystalline substance concentration of aluminum nitride (theoretical AlN crystalline substance concentration = 3.26g/(cc)). The concentration of the coat which made the vacuum evaporation chamber 900 further hot degrees, and generated it is still higher, and turns into 97-100% of theoretical crystalline substance concentration. Other CVD-AlN coat processes which used other techniques and ingredients are well-known in the technical field concerned, and include all them on these specifications by reference.

[0014]

In the another example by this invention, a coat 16 can be eliminated, and the PBN film 14 can be replaced with the CVD-AlN film 18, the heating apparatus of drawing 3 can be used, and this example is shown in drawing 5 R> 5. About 10 - 100 micrometers, the thickness of the CVD-AlN film 18 may be about 50 - 60 micrometers the optimal, and about 5 - 50 micrometers of it are suitably sufficient about 30 - 80 micrometers still more suitably.

[0015]

Drawing 3 and 5 show the example of use of the conventional PBN substrate 10. the graphite plate (the thickness of a graphite plate -- about 0.10 - 0.75 inches -- or 0.12 - 0.50 inches) covered with (1) PBN instead of drawing 3 and the PBN substrate 10 of 5 as an alternative Still more suitably the thickness of the PBN film about 0.005 - 0.035 inches And about 0.015 - 0.020 inches, (2) Thickness 0.10-according to about 0.25 - 0.50 inches hotpress still more suitably 0.75 inches boron nitride (BN) plate, Or BN plate by the hotpress covered with (3) PBN (the thickness of BN plate by the hotpress about 0.10 - 0.75 inches) The thickness of about 0.25 - 0.50 inches and the PBN film can also use still more suitably about 0.005 - 0.035 inches about 0.01 - 0.02 inches still more suitably.

[0016]

Although drawing 6 shows the heater element similar to drawing 3 and the heater element of 5, as for it,

it is made of another matter. The heating apparatus of drawing 6 has the AlN bulk substrate 20 which was formed by the hotpress, casting, or the other conventional techniques and which has still more suitably about 0.05 - 0.5 inches of thickness of about 0.1 - 0.2 inches. about 0.001 - 0.006 inches according [ heating apparatus ] to CVD again -- further -- suitable -- the thickness of about 0.002 - 0.003 inches -- having -- the pyrolytic graphite resistance element 22 similar to PG resistance element 12 -- having -- further -- it has about 30 - 80 micrometers of about 50 - 60-micrometer CVD-AlN adventitious 24 the optimal still more suitably about 10 - 100 micrometers in thickness. Still more suitably drawing 6 about 0.05 - 0.5 inches in thickness Or the about 0.1 - 0.2 inches same AlN bulk substrate 20, Still more suitably about 0.001 - 0.006 inches in thickness One or more CVD pyrolytic graphite static electricity chuck electrodes 22 of 0.002 - 0.003 inches of 0. abbreviation, The static electricity chuck which has about 30 - 80 micrometers of about 50 - 60-micrometer CVD-AlN adventitious 24 the optimal still more suitably is sufficient as about 10 - 100 micrometers. About the mechanical design of the static electricity chuck, and its actuation, those contents are included on these specifications by reference with reference to U.S. Pat. No. 5591269, 5566043, 5663865, 5606484, 5155652, 5665260, 5909355, and 5693581.

[0017]

It is optional and the heater element of drawing 6 and the static electricity chuck of drawing 6 can be combined with one equipment. The support substrate 26 which drawing 7 illustrates such a coupler, consists of the same matter as the AlN bulk substrate 20, and has the same thickness, The exoergic layer 28 which consists of the same ingredient as said resistance element 22, and has the same thickness, the pyrolytic graphite set up as the static electricity chuck element or an electrode by the above-mentioned -- the enveloping layer 32 which consists of an electrode 30 for the static electricity chuck which consists of the same matter as a conductor or the static electricity chuck electrode 22, and has the same thickness, and the same ingredient as the CVD-AlN adventitia 24, and has the same thickness is shown.

[0018]

It is optional and the coupler of the heater element shown in the heater element shown in drawing 3 , 5, or 6, the static electricity chuck shown in drawing 6 , or drawing 7 and the static electricity chuck can be used in down stream processing as a wafer carrier for moving a wafer to another location from a certain location. in this case, any of the diagrammatic example -- although -- it has an arm (not shown) and has further a means to convey a heater, a chuck, or a superheater/chuck to a desired location. In case the part (covered body) of the wafer carrier shown in drawing conveys a chip and a wafer in another location, it bears a function similar to the even part of a knife. The wafer carrier having a heater element can keep a wafer warm at the temperature of becoming hot beforehand to desired temperature, or a request. The wafer carrier which contains the static electricity chuck enables high-speed migration and compaction of the processing time. The wafer carrier which contains both of the functions as shown in drawing 7 has both advantage. However, in order to build a wafer carrier into a standard chip or a wafer rack well, the thickness of the covered body must be less than about 3mm on the whole. Therefore, the thickness of the united wafer carrier by this invention must be less than 3mm [ on the whole ] thinner than the thickness of the whole body.

[0019]

Although the suitable example of this invention was explained as mentioned above, in the example, various deformation and a reshuffle of components are possible, without deviating from the range of this invention indicated to the claim.

[Brief Description of the Drawings]

[Drawing 1]

Drawing 1 is the perspective view of a heating component suitable for use of this invention.

[Drawing 2]

Drawing 2 is drawing partially cut open, in order to expand a part of heating component of drawing 1 and to clarify an internal configuration element.

[Drawing 3]

Drawing 3 is a partial sectional view illustrating the example by this invention.

[Drawing 4]

the equipment with which drawing 4 performs chemical vacuum deposition -- illustrating .

[Drawing 5]

Drawing 5 is a partial sectional view illustrating the example by this invention.

[Drawing 6]

Drawing 6 is a partial sectional view illustrating the example by this invention.

[Drawing 7]

Drawing 7 is a partial sectional view illustrating the example by this invention.

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[Translation done.]

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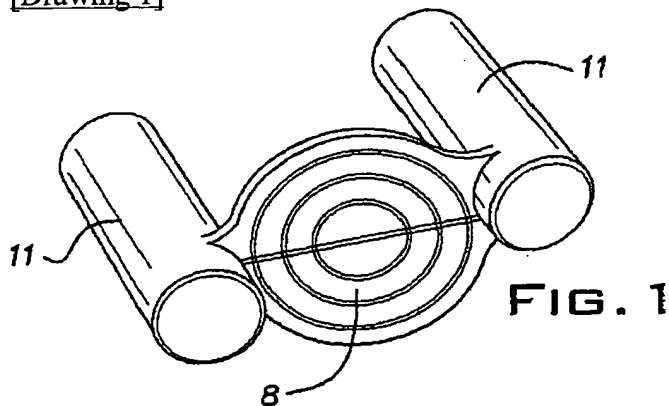
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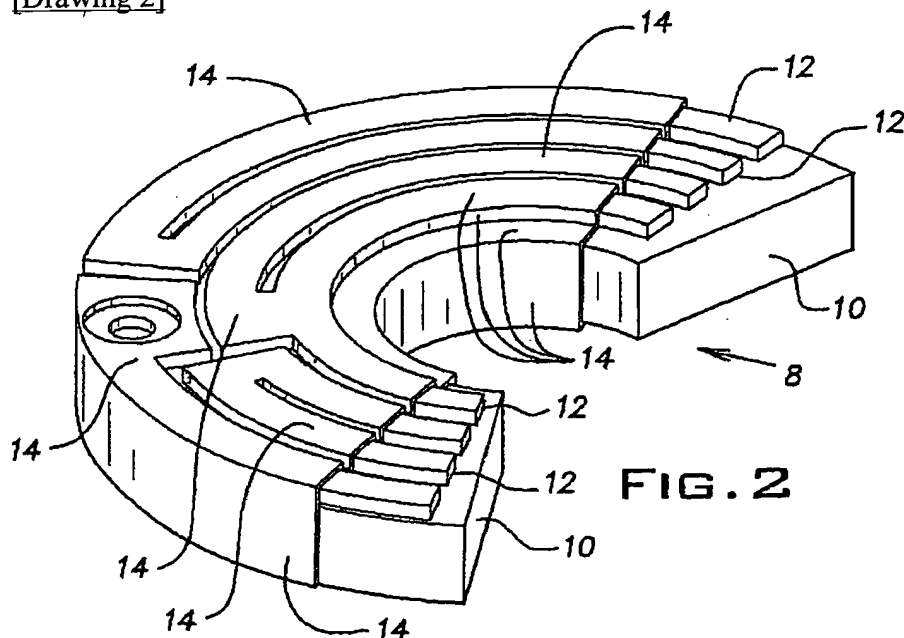
DRAWINGS

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[Drawing 1]

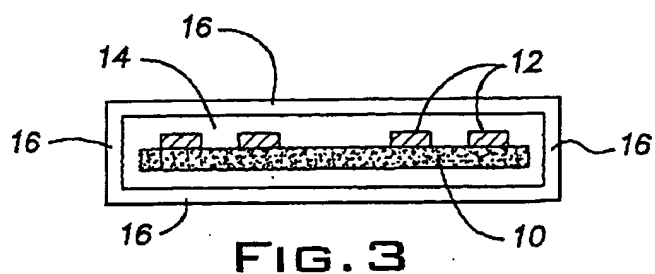


[Drawing 2]

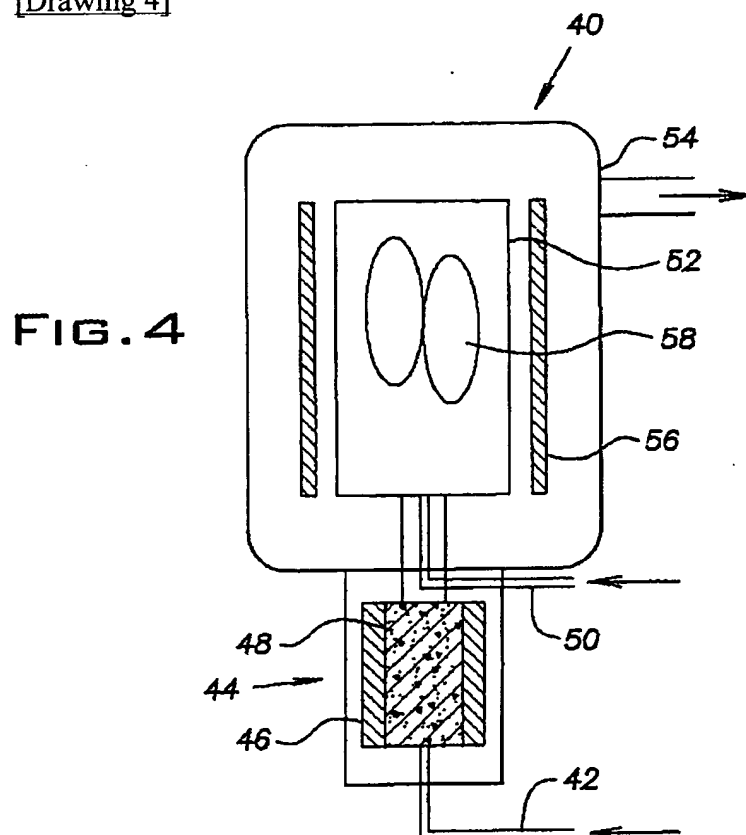


[Drawing 3]

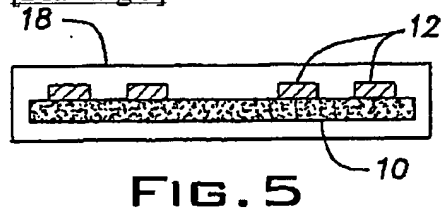




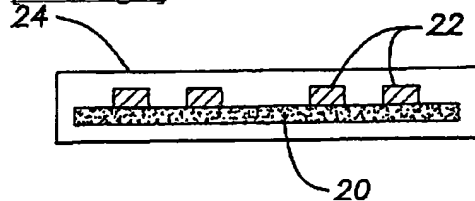
[Drawing 4]



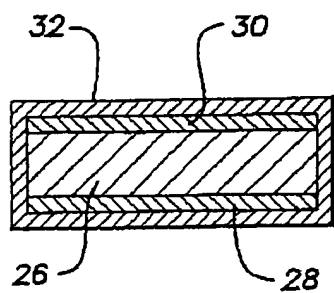
[Drawing 5]



[Drawing 6]



[Drawing 7]

**FIG. 7**

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[Translation done.]

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